THE MODEL ENGINEER

Vol. 85 No. 2109

Percival Marshall & Co., Limited
Cordwallis Works, Maidenhead

October 9th, 1941

Smoke Rings

More Workshop Philosophy

MR. WILLIAM CLEGHORN writes :—" As I have already intimated to you, I was deeply interested in your recent editorial devoted to ' Philosophy in the Home Workshop.' Since your reflections were published, Mr. Ian Bradley has contributed some further thoughts upon the same theme which, I consider, were very logical and sound in their reasoning. Whilst at work in my own workshop I have noticed the same reactions in myself as you have so well described, and also other symptoms which, while not really being covered by the definition of ' Philosophy ' are none the less connected with the acquisition of knowledge and experience. One such impression is the ' monarch of all I survey ' atmosphere which appears to surround one when in one's own workshop and which is never so complete elsewhere, unless of course, one is a Henry Ford or a Lord Nuffield. When one has attained their lofty pinnacle of success one becomes merely a looker-on at the efforts of others. The home-worker, however, is in many, if not most, cases self-sufficient and completely independent of the outside world except in so far as it supplies him with the tools and materials with which he works and converts the abstract ideas of his brain into the concrete realities, successful or otherwise, which adorn his shelves. Should a large part of his workshop equipment have been made by himself he then has additional cause for pride and a correspondingly greater feeling of independence and is even in danger of becoming smug and self-satisfied. Another aspect of the home-worker is his capacity for tackling jobs which are really beyond his experience, often very limited, and which are truly the province of the highly-skilled professional. In fact, an expert would approach some of these operations with great caution if not actual trepidation. The tyro, however, justifying the old adage that 'fools rush in where angels fear to tread,' takes these difficulties in his stride and often his ignorance of the pitfalls enables him to pass right over them without even noticing their existence. This latter statement may at first sight seem to be illogical, so I had better give an illustration of my meaning. The readiest, to my mind, lies in the building of a model locomotive, the construction of which is described with great facility by 'L.B.S.C.', to whom I tender apologies for the use of his soubriquet. Now when ' L.B.S.C.' describes the making of a locomotive there are probably dozens of readers who set out to make it having had little, if any, previous experience, and although some may never complete the model, others evidently do. My point is that although ' L.B.S.C.' describes these constructional details with such ease there must be quite a number of the details involved which call for extra special skill and care and which even ' L.B.S.C.', himself has to deal with circumspectly. Yet the novice, who has not one hundredth part of the skill and experience of ' L.B.S.C.', will tackle the job and make quite a good shape at it. That this is a fact is proved by the number of first attempts which we see and read about in THE MODEL ENGINEER. No disrespect is intended to ' L.B.S.C.', for to be quite fair to him one must admit that he is very painstaking in his descriptions and consistently points out the pitfalls and places where care is needed, and while I am not a locomotive ' fan ' myself I always enjoy reading " L.B.S.C."

From a Corporal in the R.A.F.

SCARCELY a week passes in which the editorial postbag does not contain at least one letter bringing news of model engineering activities by the gallant lads in the fighting services. Some of these activities are organised officially, as part of the training of younger recruits ; but others are due to the enthusiasm of individual privates, N.C.O.'s and officers, who often succeed in imparting their keen interest to some of their colleagues who may never have previously given a thought to the building of models. An interesting letter from a corporal in the R.A.F. came to hand just recently. It tells of his having been made a present of Volumes 80 and 81 of THE MODEL ENGINEER, with the result that he has been fired with the urge to take up *the* hobby once more ; and it goes on : " Although I have read most copies of THE MODEL ENGINEER from 1900 to 1920 (my father was an enthusiast), I have never taken up the subject really seriously, and have never constructed anything really ambitious, or should I say ' attempted ' ? The splendid articles by ' L.B.S.C.' and Mr. Westbury make my fingers itch to attempt the *Bat, Miss Ten-to-eight,* or a 15 c.c. racing hydroplane ! Unfortunately, my tools at the moment comprise a few files, tin-snips, 4-6-8 B.A. taps and dies, a hand-brace and a few drills, a soldering-iron and a hacksaw. No vice, no lathe ; how I envy ' L.B.S.C.' ! Perhaps, some of your readers, on their junk-heaps, have unfinished boilers, cylinder-blocks, etc., for which they have no use. I could collect same, if within easy distance of this depot ; or I am quite willing to pay postage. Incidentally, anything in the way of bits and pieces, not necessarily boilers or cylinder-blocks, would be warmly welcomed, as I have interested some of my men in the subject. We have not a lot of spare time on our hands, but we would like to forget our job, at times, and relax. . . . This is certainly rather a cadging letter ; but it is only through the good services of other model makers and yourself . . . that we can hope to get anything." The corporal then goes on to say that he has already made a start by endeavouring to convert a $1\frac{1}{2}$-in. $\times$ $1\frac{1}{2}$-in. two-cylinder air compressor to a high-speed steam engine, piston-valve type. Also, that his second-in-command, having a knowledge of woodwork, is contemplating the construction of Mr. Westbury's 24-in. racing hydroplane, which means that they will be busy during the long evenings, designing a suitable power unit for it. If any reader of THE MODEL ENGINEER would care to help our friend, by the gift of tools and scrap materials, would he please let us know ?

Percival Marshall

"Five Minutes in the Lobby"

By "L.B.S.C."

DURING the past few weeks I have received quite a number of letters asking, among other things, where castings and material can be obtained for various locomotives described in these notes. Unfortunately, your humble servant is not in the position of the conjurer who can produce rabbits and umpteen other things out of a hat, nor am I able to create the required goods out of thin air; nobody wishes more than myself, that everybody's needs could be supplied. Some of our advertisers who had good stocks at the beginning of the present upheaval have not yet sold out; and if enquiries are addressed to them, the required castings or material may be forthcoming. As regards fresh supplies, foundrymen now require a permit or a contract number before they can supply small iron castings, otherwise they cannot obtain material; and such permits are not, of course, issued for such things as 3½-in. gauge locomotive wheels. However, there are still many small foundries who have some old scrap metal on hand, and if they are supplied with a decent pattern, can put it into a moulding-box among more important articles, and deliver the much-needed casting. The odd cylinder, or wheel, whatever it may be, has about as much effect on the "war effort" as a teaspoonful of water taken out of the Atlantic Ocean, whilst it provides, maybe, a "war-worker" with just that little "break" which prevents him from becoming a fit and proper candidate for the loonies' home.

Don't Scrounge

Before anybody complains that they cannot get sheet metal, rod, or tube, from our advertisers, or from other recognised sources, they should look around to make certain that they have not overlooked any local sources of supply. The old saw about "Not being able to see the wood for trees" is very applicable in many cases; as I have often remarked, it is the obvious that is most frequently overlooked! For example, war or no war, domestic plumbing needs occasional repairs and renewals, and most ironmongery and hardware stores stock sheet metal, tube, and other materials used by our friends of the H_2O brigade, much of which can be utilised in our own particular job. Then again, there is always the question of using discarded or scrap material. The amateur worker's scrap-box is a standing joke; but on our local munition dump I have seen plenty of material, useless any more for its original purpose, maybe, but good metal which would serve our purpose equally well as new. Don't run away with the idea that I am suggesting anybody should go around the munition dumps on what is popularly known as "the scrounge"—far from it! But before throwing anything away, even in a good cause, it might pay to see if it can be utilised by the owner first.

In my young days, a housewife for whom I had done several small jobs produced a broken fender and asked if it would be of any use. The bottom of it was 18 gauge sheet steel; and as she had been busy with her blacklead brush whilst the fender was in service, the steel had a perfect surface and was not corroded nor rusted in any way. The cast-iron frame had broken, but the top rail of 1½-in. brass tube was intact. I accepted the gift with joy; and the sheet steel furnished enough material for all the platework of two odd-sized hybrid locomotives, the soft cast-iron frame hacksawed up into buffer beams, bogie centres and bolsters, frame stretchers and the like, whilst what I didn't use of the brass tube in its original form, was split, opened out and flattened, and used as sheet brass. That is just a case in point, and I know of many others. Another old saw says "Where there is a will, there is a way," and it is very true.

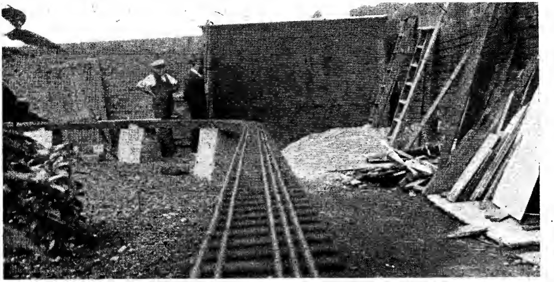
Nothing Doing

Now may I correct an erroneous impression? Some readers have asked, as a special favour, if I can supply their needs from my own stock. How the impression ever got around that I had any stock, or could "pull the strings" to obtain any, goodness alone knows, unless it was my mentioning that I had plenty of material in hand to build the 3½-in. gauge Webb compound. Anyway, for new readers' benefit, and to save useless and futile correspondence, may I repeat that I am a private individual, unconnected with the trade in any way, and therefore not in a position to supply, or obtain supplies, for anyone. Before the upheaval, I used to "go shopping" in feminine style, driving my gasoline cart up to town, and buying what odds and ends I needed, over the counter of any metal merchant's or other store that took my fancy; "Cash and carry," as our cousins over the pond call it. Also, feminine-like, I always bought a little more than what I needed, so that I would never be stuck for material in any experimental work that I might undertake. Consequently, when the lid of Hades blew off for the second time, I had sufficient to carry me along; but it is now over two years since last I turned the car's head to the south, and piloted her homeward through brightly-lighted streets in the early evening. That run remains in my mind's eye as a cherished memory, for never again shall I see the streets, shops and houses as I saw them on that particular evening; you don't need telling why. Enough said!

Half Measures are No Good

Followers of these notes have often read therein that I can only guarantee success if the instructions given are implicitly followed, and that means exactly what the words convey. If alterations are introduced, or anything omitted or added, it converts the "words and music" into discord, as Mr. Harrison aptly puts it, and the result is disappointment. On scanning through the description of a rebuilt "Sir Sam Fay" by Mr. Eccles in August 28th issue, I note that he says the alteration to the original valve gear, made to my published notes, was not a success, and he had to shorten the distance between the radius-rod and die-pins by over one-half, as the engine ran jerkily and "apparently had too much lead."

Now I have altered several sets of that particular valve gear, *and in every case* have set the radius-rod pin and die-pin 7/32 in. apart. Where Mr. Eccles slipped up was that he apparently did not finish the job, and left the ports and valves in their original condition. The addition of a lap-and-lead movement to the gear, made to the dimensions I gave, has the effect of increasing the valve travel, and renders the existing ports and valves next door to useless for correct valve setting and efficient working. On all the engines with the altered gear, I have opened out the ports as big as the steam chest would allow, and made a new pair of valves to suit. These valves had laps long enough to show just the usual crack of port opening when the main cranks were on the dead centres; and the exhaust cavity



Birmingham S.M.E. railway—" the contractors on the job "——

had my usual 1/64 in., or thereabouts, of inside clearance. If Mr. Eccles got too much lead with the pins set 7/32 in. apart, it is quite obvious that he either used the original valves unaltered, or made a fresh pair much too short. I appreciate his comments that the rest of the " Live Steam " brand of improvements were successful, and would ask him, when he gets the time and opportunity, once again to make a new pair of vibrating links with the pins 7/32 in. apart, open out the ports as given above, and make a fresh pair of valves long enough to show the " black line " on each dead centre, as mentioned above. I can assure him that the result will be what is popularly termed an " eye-opener," as the engine will be much livelier, the beats more snappy, the acceleration better, and the fuel and water consumption much lower than they are now, even with the improvements he has already effected.

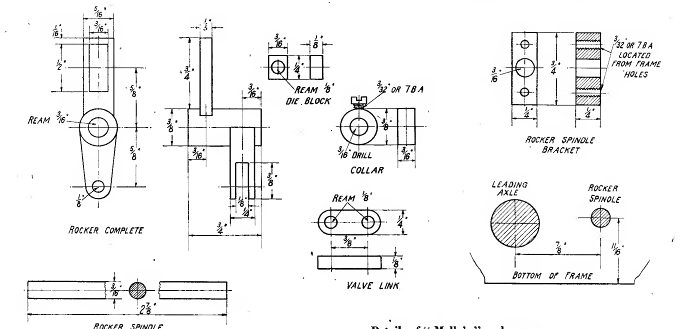
Photos. by] ——" **and the road in use."** [*W. Finch*

"MOLLY"

Valve Rocker Gear

Anybody who owns or has access to a fairly hefty milling machine could, if they so desire, mill up each rocker bearing with the two arms, from a solid piece of steel bar, ⅜ in. by ¾ in. section, and about 2 in. long. Simply mark out on one side, catch it in the machine vice, and mill away the surplus metal at either end, leaving the arms sticking out of a ⅜-in. square centrepiece. The centrepiece should then be drilled 9/32 in., and mounted on a mandrel either held in the chuck or placed between centres, and the middle part between the arms, and each end, turned to ⅜ in. diameter, the surplus opposite the arms being hand-filed to match. The arms should then be drilled and slotted, as sketch, and the 9/22-in. hole bronze bushed, an oil hole being drilled in the middle between the arms.

I guess, however, that most builders of " Molly " will prefer to build up the rocker assemblies, and in that case the centre part, or boss, is just a ¾-in. length of ⅜-in. round mild steel, or bronze. Chuck in three-jaw, face the end, centre, and drill a No. 13 hole through it. At 3/16 in. from one end, mill or file a slot ⅛ in. wide, about one-third of the way through the boss; at the same distance from the other end, mill or file another slot ¼ in. wide and halfway through the boss. The arm that carries the die block is 13/16 in. long, 5/16 in. wide and ⅛ in. thickness, and made from mild steel. Mark out the oblong opening as shown in the sketch, drill two 5/32 in. holes in it, then file out to given dimensions, leaving the opening ½ in. long and 3/16 in. wide. The forked arm is made from a piece of ¼-in. by ⅜-in. mild steel bar ¾ in. long, slotted as described for coupling-rod knuckles, etc., and filed to shape. Drive the arms into their respective slots in the boss; then, if the boss is steel, braze them in position, or if a bronze boss is used, silver-solder them.



Details of " Molly's " rocker gear.

Put the drill through again, or else use a rat-tail file, to take out the bits of the arms projecting into the centre hole in the boss. If a steel boss is used, it will need bushing, so poke the 9/32-in. drill through, then turn up a bush from a bit of 5/16-in. bronze rod to a tight drive fit in the 9/32 in. hole. Drill it No. 13 whilst still in the chuck; part off, squeeze into the hole in the boss, and then poke a 3/16-in. parallel reamer through. If the boss is made from bronze rod, it will not require any separate bush; just put the reamer through it. Drill an oil hole as mentioned above.

The die block is a simple job and should be filed up from a bit of hard bronze, such as a 1/8-in. slice parted off a length of 3/8-in. P.B. rod held in three-jaw. It should be a nice sliding fit in the opening in the upper arm of the rocker, and the hole should be drilled No. 32 and reamed 1/8 in.

Collars, Links and Spindle

The two collars are made from 3/8-in. round rod, either brass or steel will do. Chuck in three-jaw, face, centre, drill 3/16 in. for about 5/8 in. depth, and part off two 3/16-in. slices. Each one is fitted with a 7 B.A. or 3/32-in. set-screw entering a tapped hole in the edge, as shown.

The valve connecting-links are filed up from 1/8-in. by 1/4-in. mild steel rod, the holes being drilled No. 32 at 3/8-in. centres, and reamed 1/8 in. They should be casehardened, as previously described for other parts. The rocker spindle is just a 2 7/8-in. length of 3/16-in. round steel, silver-steel for preference, and is supported by two bearings or brackets which are simply 3/4-in. lengths of 1/4-in. square brass or steel rod, with a 3/16-in. hole drilled in the centre of each. They should be a tight push fit on the ends of the rocker spindle.

How to Assemble and Erect the Rocker Gear

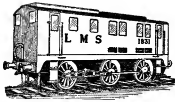
Put the two valve links in the forks of the lower rocker arms, and secure them with pins made from 1/8-in. silver steel. If the pins are not a tight fit in the arms, a few taps with a hammer at each side of the fork, will put a slight burr on them, sufficient to prevent them falling out. The links should work easily on the pins without shake. Now slide the rockers on to the spindle, with the thinner arms to the inside, and put on the retaining collars; next put the brackets on each end of the rocker spindle. The complete assembly is then placed in position, this being shown in the detail sketch above. The exact location of the rocker spindle should be 7/8 in. behind the leading axle; and if the hornblocks have been made exactly to the dimensions given, the spindle will be in its right place when the two brackets are hard up against the sides of the leading hornblocks, the centre of the spindle being 11/16 in. from the bottom of the frame. Clamp temporarily in position given, then drill No. 40 holes through the frame, above and below the spindle, letting the point of the drill just penetrate each bracket. Follow up with No. 48, tap either 3/32 in. or 7 B.A., and put in countersunk screws. Line up the lower arms of the rockers with the valve crossheads or forks, insert the links in the latter, and secure with little bolts made from 1/8-in. silver-steel, nutted at each end. If the ends are turned down to 3/32 in. diameter, and screwed either 3/32 in. or 7 B.A., using nuts to suit, it makes a much neater job than if 1/8-in. or 5 B.A. nuts were used on the end of plain screwed pins. Adjust the collars so that they bear lightly on the outside ends of the rocker bosses, and tighten the set-screws. The rockers should operate the valves easily when worked with your fingers, but there should be no " slop " nor lost movement. Don't fit the die-blocks until the lifting gear is made, and the rest of the doings all ready for final assembly.

BLUE TRAINS

As an experiment the L.N.E.R. are applying a new colour scheme to some of their red and cream Tyneside Electric coaches when they are in need of overhaul and repainting.

The cream colour above the waist of these vehicles has been retained, but below, separated from the cream by a black line, a striking shade of blue, similar to that used on L.N.E.R. streamline locomotives, has been introduced.

The numbers are painted black, whilst centrally in the blue panel is displayed the Company's totem, a simple lozenge-shaped emblem containing the initials L.N.E.R. in black letters on a cream background.



1831 . . .

★A $3\frac{1}{2}$-in. gauge I.C. Engine-driven Locomotive

By Edgar T. Westbury

Flywheel and Clutch Assembly

THIS group of components, which provides the first stage in the transmission of power from the engine to the track wheels, is shown in Fig. 72. It will be seen that the flywheel, which is mounted directly on the engine shaft in the usual way, is connected to the transmission shaft through an automatic centrifugal clutch. The object of this clutch is to limit the torque load demanded of the engine, in proportion to the r.p.m. at which it is running, irrespective of the speed and torque of the transmission system, and to disconnect the engine entirely whenever its r.p.m. falls below what is considered to be the effective range. In this way, it becomes practically impossible to " stall " the engine when manoeuvring under load, so long as it is reliable in itself and is not throttled down beyond a safe idling speed. The clutch has no manual control whatever, as it is not necessary for it to be disconnected manually by the driver in any circumstances. It is not to be regarded so much as a strictly essential part of the transmission system, so much as an added convenience and a means of simplifying the driving controls. A careful and considerate driver might never feel the need for such a clutch, and it may be mentioned that no fitting of this nature is employed in the 15 c.c. experimental locomotive made by Mr. Ripper, which has now had quite a fair amount of running during the summer season, and has given no trouble, either in the transmission system or otherwise. Anyone, therefore, who wishes to dispense with the clutch, in order to simplify construction, may do so with the assurance that its absence will not make the locomotive a failure, except in the hands of an unusually clumsy or careless driver, or, worse still, one who is *determined* to show that it lacks the inherent flexibility of a steamer. If direct drive is adopted, it may be arranged without making a great deal of difference in the construction of the main components, and I suggest that the best method is to convert it to a " cushion " drive, by fitting rubber blocks inside the rim of the clutch housing, and using driving pins in place of the eccentric pivots in the face of the flywheel.

It may be appropriate to mention here that the design of this clutch has called for considerable thought and experiment, as it is by no means an easy matter to devise a simple and satisfactory automatic clutch within the space limits allowable. I think, however, that most constructors will agree that the complication of the device has been cut down to the very minimum, and there is no doubt about its ability to transmit the required torque at normal engine speeds. In case any readers are not familiar with the working principles of a centrifugal clutch, it may be mentioned that it consists of a more or less normal form of friction clutch, in which the pressure of the friction member (which transmits the torque from the positively-driven to the floating shaft) is controlled, partially or entirely, by centrifugal force. Thus, the amount of torque which the clutch will transmit is proportional to the speed, and it may be arranged to release all pressure on the friction member below a certain minimum speed, so as to provide a " free engine " when idling. In the present instance, the required centrifugal force is provided by four pivoted weights carried by the flywheel, and faced with friction material on their outer faces, so as to grip the inside surface of the drum which forms the clutch housing.

The weights are drawn inwards by means of four tension springs, so that when the engine is stationary, or running at idling speed, the toe of each weight rests on the pivot boss of the next. In this position they are free of engage-

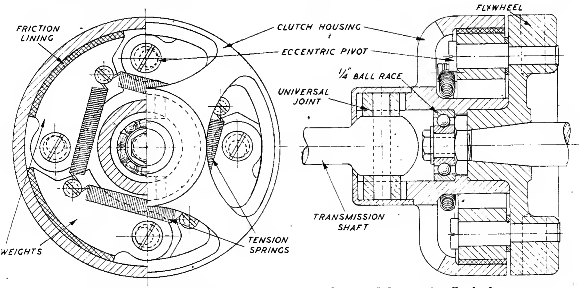


Fig. 72. General arrangement of automatic clutch assembled on engine flywheel.

* *Continued from page* 248, " *M.E.*," *September* 25, 1941.

ment with the clutch housing, which has no positive connection with the flywheel, but runs freely in concentric alignment with it, on a ballrace fitted to the extension spigot of the crankshaft, and also on the flywheel boss. When the engine is accelerated up to a speed sufficient for the centrifugal force exerted by the weights to exceed the inward pull of the springs, the friction surfaces of the weights make contact with the inside of the housing and commence to take up the drive. If the torque load is greater than that which can be transmitted by the weights under the conditions of speed and centrifugal force existing at the time, the clutch will slip to a greater or less extent. It follows, therefore, that, under "stalling" conditions, when the engine is unable to produce the torque momentarily required to propel the locomotive, and its speed falls off through overload, the clutch will automatically release and allow it to recover speed, so as to gradually "pick up" the load, instead of "conking out."

One very important problem in the design of this clutch was that of providing adjustment to compensate for wear of the friction linings (more correctly *facings*, but the term "linings" appears to be universally used in connection with brake and clutch mechanisms). It will be obvious that, if the weights are pivoted at a fixed radial point on the flywheel, any variation of thickness of the linings will interfere with their full surface engagement, and thereby reduce the amount of torque which can be transmitted by friction. It was, therefore, necessary to arrange for some means of adjusting the pivots radially, and the simplest method of doing so was by making the part on which the weights are mounted eccentric to that which secures them to the flywheel. So far, the matter was quite simple; but it was also necessary to provide some thoroughly reliable means of locking the pivots when once adjusted, which would effectively avoid the risk of any parts coming loose when running. After trying out and rejecting several more or less complicated locking devices, a form of locking screw was arrived at which not only holds the pivot very securely, but is itself absolutely immune from the risk of coming adrift—a feature which experience had proved to be most essential, on the principle of *quis custodiet ipsos custodes*, which means, in plain English, "Who takes care of the caretaker, while the caretaker is taking care?" This locking screw is not visible in Fig. 72, as it is not on the plane of section, its position being vaguely indicated by dotted lines; but it is shown in position in the detail drawing of the flywheel, Fig. 73.

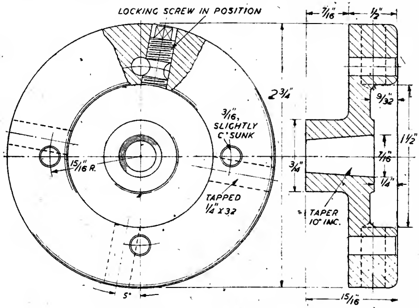


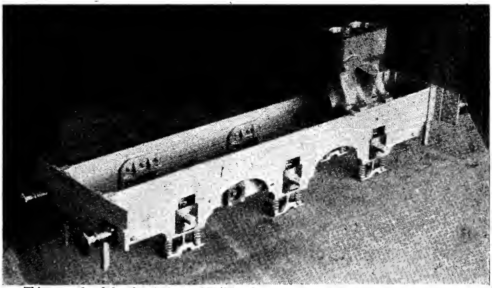
Fig. 73. Details of flywheel, showing pivot locking screw *in situ*.

Flywheel

The most suitable material for this component is mild steel, if a blank of the required size can be obtained; but, if not, a sound casting in hard bronze or cast iron will be quite satisfactory. Machining is quite straightforward, the chief essentials being that it is bored to fit the taper on the shaft quite securely and runs truly all over. To ensure this, the boring and as much external machining as possible should be done at one setting, and the rest finished by mounting the job on a taper mandrel. It may, however, be advisable first to chuck the flywheel spigot outwards for roughing down the rim, front and boss, also facing the latter before reversing it for boring, as it will be more rigidly held in this way than when mounted on the mandrel for finishing. In the boring operation, the utmost care should be taken to ensure that the taper matches that of the shaft accurately. I do not recommend the use of "short cuts to precision" in this sort of job, such as attempting to machine external and internal tapers at one setting of the slide-rest. While these methods may work fairly well in some circumstances, the trouble is that they seem so simple and obvious that many workers regard them as absolutely infallible, and take them for granted without question. Whereas, in actual fact, their accuracy depends upon hairs-breadth adjustment of the height of the cutting tools, the alignment of centres, and clearance of mandrel bearings; and in a taper which is only 7/16 in. diameter at the large end, one cannot afford to take liberties. The only reliable method I have found for matching tapers is to "cut and try," using some form of marking to detect the point of contact when approaching final accuracy. A few lines along the cone of the shaft with an ordinary lead pencil are quite sufficient for this purpose. Don't attempt to correct inaccuracy of angle by lapping; I have explained before why this method doesn't work. It is better to apply a Swiss file to the cone of the shaft to make it match the bore, but this expedient should not be necessary if due care is taken with machining.

Perhaps I may be excused for the emphasis which I place on this operation, in view of its importance in the ultimate success of the engine; I have seen only too often the effects of neglecting to take proper care over it. A badly-fitted taper seating is an eternal nuisance, but in this particular instance it is likely to be even more troublesome than usual, as the flywheel nut is not readily accessible when the engine is fully assembled, and thus the usual remedy of applying a little more brute force in tightening it up, after slip has taken place, cannot be adopted. It will be noted that considerations of space have made it necessary to use a rather thin nut, which will require a certain delicacy of handling; it would have been possible to use a thicker nut at the expense of some of the length of the taper, but I have considered the latter the more important. A temporary nut of more robust proportions may be used for drawing the flywheel up, before the proper nut is fitted.

The four pivot holes should be carefully marked out on the flywheel face, so as to be exactly even in spacing and radial distance. It will be seen that the locking screw holes are situated 5 deg. off the radial line of the pivot



This example of the chassis for "1831" has been constructed by Mr. Ian Bradley. The main casting of the engine, partly machined, is shown resting in position on the bearers.

holes. In order to avoid the risk of the drill wandering out of truth when dealing with intersecting holes such as these, it will be advisable first to drill pilot holes, say about 3/32 in. diameter, in both cases. The small holes are just clear of each other, and when larger drills are used for opening them out, they will follow the true centres if due care is taken. A reamer should be used for finishing the pivot holes after the locking screw holes have been tapped.

Clutch Weights

It is most important that these should be identical in shape and weight, and they should therefore be machined all over. The most convenient way of doing this is to make them in a continuous ring, and saw them apart after machining, as indicated in Fig. 74, which shows a single casting used to form the complete set; it would, however, be a fairly simple matter to make them from the solid bar material if available. Bronze is the most suitable metal for the job, though iron, steel, or brass may also be used. After separating the individual weights, they may be clamped together for shaping the toes and bosses, and after one of them has been drilled, it may be used as a jig to drill the rest. The pivot holes should be reamered, and an oil hole should be drilled at an angle into the boss, so that it comes in an accessible position when the clutch is assembled.

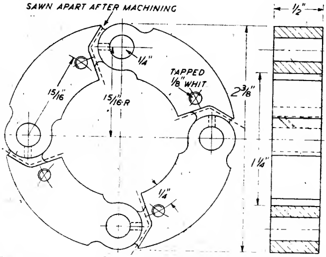


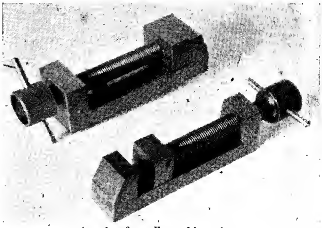
Fig. 74. Set of clutch weights, made in one piece and afterward separated (1 set off).

The weights are faced with strips of 1/16-in. bonded asbestos brake lining, attached by four countersunk brass screws, about 7 or 8 B.A. These must have the heads sunk well below the surface of the fabric, so that they cannot foul the inside face of the housing. It may be mentioned that a special grade of "Ferodo" brake lining having a very high coefficient of friction is obtainable in the required thickness for this purpose.

(To be continued)

Small Machine Vices

The photograph herewith shows a pair of small machine vices that have proved invaluable for all sorts of milling and drilling operations. The larger of the two has a jaw width of 1⅛ in., whilst the smaller is ¾ in. wide. Both vices admit a maximum of 2½ in. between the jaws. If a shaper is available, vices of this type may be machined from the solid; there is no objection to building them up by brazing, but in this case it is advisable to put a pair of good pins (say 3/16 in.) in the fixed jaw and the threaded buttress before brazing.



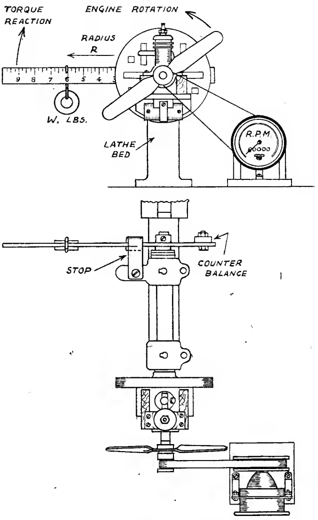
A pair of small machine vices.

When the vices are finished it is a good plan to drill and countersink two holes in the base of the vice. The holes should have the same centres as the T-slots in your lathe boring-table. I have found in some milling operations that it is convenient to grip one vice in the other, but when doing so I ensure against slip by packing with pieces of cigarette packet, a procedure which also protects the vices.

The short permanent tommy-bars in the knurled thumb-screws are held in position by lengths of light coil spring which slip over the tommy-bars inside the hollow of the thumb screws.—I.B.

A Simple Method of Brake Testing

By R. H. R. Curwen



Elevation and plan of the lathe set-up for brake testing engines.

THE measurement of brake horse-power seems to be commonly regarded as a job which requires special apparatus and complicated calculations, and it appears that the majority of constructors of model petrol engines are content to limit their testing to the checking of the maximum r.p.m. obtained. A small propeller is usually fitted for the purpose of cooling the engine and providing the load.

The maximum speed at which an engine will rev. is, of course, some guide as to the performance, but a great deal more can be learnt by brake testing and the plotting of power curves, a simple method of which is described in the following notes. Carefully carried out, this method has been found to give accurate results.

Revolution Counter

Apart from the lathe, the only piece of equipment required is a revolution counter which can be obtained in the form of a motor-car speedometer from the car breakers. That used by the writer is of Smith manufacture, and is mounted on a wooden base, as shown, the threaded boss for flexible shaft being sawn off short to expose a suitable length of the spindle to take a driving pulley.

The meter must now be calibrated in r.p.m.; which can be done in several ways. In this case, a worm-driven rev. counter was available and, with the aid of a stop-watch, readings were taken from the electric motor and grinding-head, to which the speedometer spindle, fitted with a rubber point, was also applied. Alternatively, a belt drive could be used from a convenient pulley on the countershaft or lathe and the counter applied direct to the spindle of the speedometer.

It is, of course, possible to dispense with the belt-driven rev. counter altogether and use the worm-driven counter for testing, but the small amount of time spent in adapting a speedometer will be repaid by its greater accuracy and convenience in use. As the speedometer obtained by the writer was conveniently found to read 1 mile per hour per 50 r.p.m., it was not thought necessary to make a new scale for the dial.

The Lathe Set-up

Turning to the lathe, the mandrel is reversed in the headstock in order that the propeller or air brake used may have sufficient clearance, and it will probably facilitate matters to swing the lathe round to a convenient position on the bench.

The complete rig-up is shown in the drawings, where it will be seen that the engine is mounted on an angle-plate fitted to the faceplate, but other fixing arrangements will be required to suit different engines; the important point being that the engine crankshaft should be co-axial with the lathe mandrel.

Coil, condenser, and petrol tank should be clipped on adjacent to the engine.

It is advisable to balance the faceplate by fixing change wheels, or other suitable weights, where required, but this is not essential; provided that the engine is in equilibrium at the vertical or normal running position the error introduced will be very small.

Propeller

The air brake used is cut to propeller shape (and balanced) from metal approximately 1/16 in. thick, the pitch being varied, for different loading, by twisting the blades. A nicely-made variable pitch prop. would be handy here. In front of the prop. is fitted a $\frac{3}{4}$-in. pulley for the rev. counter drive, which is taken by a light belt made from cotton tape, $\frac{1}{2}$ in. wide, with the ends lapped and sewn together. A wooden pulley of 3 in. diameter is pressed on to the spindle of the rev. counter, which gives a ratio of 4 to 1 and, therefore, a full scale reading of 12,000 r.p.m., sufficient for most engines; it may be necessary, however, to vary this ratio with instruments of different make.

Rotation of the mandrel is limited to a few degrees by a stop, fixed to the headstock or to the saddle, which

consists of a U-shaped strip, bent to allow slight up and down movement of the balance arm. The arm itself should be at least 15 in. long and marked off in $\frac{1}{4}$-in. divisions from the mandrel centre, to which it is locked by the change-wheel collar, and should be carefully balanced, before fixing, by a suitable counterweight at the plain end.

The sliding balance weight of approximately 2 oz. for engines of 5 c.c., and *pro rata* for other sizes, is suspended from the balance arm by a loop of wire which registers in small notches filed across the top edge of the arm over each calibration.

Horse-power

A short description of the mechanics of the system may be of interest to those whose knowledge of the subject is limited to the fact that one horse-power is equal to 33,000 foot-pounds per minute. This means that 1 h.p. is the power required to raise a weight of 33,000 lb. a height of 1 ft. in 1 min., or a proportionately lighter weight in a proportionately shorter time.

If it were practicable, therefore, the simplest method of measuring the power would be to find the time taken to lift a known weight by means of a cord and drum fixed to the engine shaft, in which case the number of feet per minute by which the weight would be raised would be equal to 2π RN where R is the radius in feet and N the r.p.m. turned by the drum. Multiply this by the weight W lb. and you have the power in ft.-lb., which, divided by 33,000, is converted to horse-power.

Friction Devices

To eliminate the weight and cord, the drum could be loaded equally by applying friction to its circumference, and this method is commonly used in brake testing. Certain difficulties arise, however, in friction devices of this kind when used for the testing of small high-speed engines, and to measure the power direct from the crankshaft satisfactorily, some form of hydraulic or electrical dynamometer is required. It is not proposed to go further into these systems here, as the subject was dealt with in this journal some years ago.

Returning to the method employed here; when torque is exerted in a clockwise direction, through the crankshaft, to the propeller, an equal and opposite force, known as the torque reaction is exerted by the engine body, which tends to rotate anti-clockwise. The torque reaction is therefore transmitted, through the engine bearers and mandrel, to the balance arm, where it can be recorded and converted to b.h.p. Here the principal is exactly the same as in the case of the drum already referred to; the balance weight, W lb., being equivalent to the weight raised, and the length of arm to the radius of the drum.

The power developed by the engine is, therefore, calculated from the formula :—

$$\text{b.h.p.} = \frac{2\pi\text{RNW}}{33{,}000}$$

where $\pi = 3.142$, R = length of arm in feet, N = revs. per min., and W = weight in lb.

Testing

The procedure is as follows :—

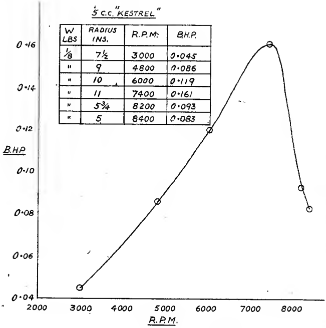
The engine is started up and adjusted to run at maximum revs. The position of the balance weight, W, is adjusted until the arm is just floating between the stops, and radius, R, noted and converted to feet. R.p.m. are also recorded.

To take new readings, the prop. blades should now be twisted to a slightly different pitch in order to change the load and revs. It is convenient to tabulate the readings obtained as set out on the power curve, which shows the result of a test carried out on a 5 c.c. "Kestrel." As can be seen, this engine develops a maximum of 0.16 b.h.p. at 7,400 r.p.m.

The lathe used for the testing of a number of two-strokes, ranging from 1 c.c. to 15 c.c., is a $3\frac{1}{2}$-in. "Myford," but anything with a pair of good bearings can be adapted for the purpose. If a considerable amount of experimental work is contemplated, it would be quite a simple matter to construct a proper testing bench with the mandrel running in a pair of plummer blocks.

For Steam Engines

It might be assumed that the only types of engines which can be tested, by the method described, are those which are self-contained and suitable for mounting on a faceplate; the gear could be used indirectly, however, to cover almost any type of engine or motor. This could be done by plotting a power curve for a given propeller when driven by a petrol engine at various speeds on the dynamometer; this prop.



Power curve of "Kestrel" engine.

could then be fitted to a steam engine the power of which could be determined at any speed by reference to the curve. The only difficulty here would be the matching of the prop. to the engine on test, i.e. to find the correct propeller to absorb the maximum power output. If we have two engines of equal power but of widely different speeds, it is clear that the slower engine will require a larger prop., or one of greater pitch, to absorb its power, than the faster.

The writer has a number of propellers, each one calibrated, which are suitable for a fair range of engine types, but one of variable pitch has been designed with the blade sockets calibrated in 5 deg. divisions, a separate b.h.p./r.p.m. curve being plotted for each angle. By this means it should be possible to measure the power output of most model engines.

The Oil Engine as a Model

Difficulties encountered in reproducing the oil engine on a small scale—and a few suggestions as to how the problem might be dealt with

By B.C.J.

IS it not a fact of striking significance that, whilst it is possible to purchase a small model steam engine with one or several cylinders, horizontal or vertical, and of excellent design and workmanship, it is totally impossible to procure any small-scale working model of another well-known prime mover—the oil-engine ? Indeed, a very curious state of affairs is suggested by the above statement. Most of the small model stationary steam engines marketed by the leading makers of models are not in any way represented as full-size machines in the factory, workshop or elsewhere. It would appear that not only is the small independent steam engine not now manufactured—but it is a matter of considerable difficulty even to call to mind any site where such a form of power may be seen in operation. Change and decay is the order of worldly affairs—and the small steam engine, sad to relate, has suffered decay, and is, indeed, to all intents and purposes, *dead*. Its poor economy, its need for constant attention, its troublesome boiler, and other shortcomings have killed it. But to the model-maker—amateur and professional—it is still a constant source of interest. The amateur still derives pleasure from the operation of the steam engine in miniature, and the professional derives profit therefrom. It is extraordinary that a working *model* of a defunct appliance should be capable of exciting so much enthusiasm amongst those whose interest lies in the *construction* of models—and amongst those who merely like to *run* them.

The Slow-speed Diesel

Before proceeding, it is perhaps desirable to set down rather clearly the main purport of these notes. The writer is, of course, quite cognisant of the fact that certain diminutive *petrol* engines, with cylinders of less than 1¼ in. in diameter, are procurable at the present time. Such engines have been designed primarily for the propulsion of small speed-boats and for driving the propeller of the model aeroplane, but as such they do not really resemble at all closely engine design such as would certainly occur in the case of the speed-boat—or aeroplane of full-scale dimensions. Now, it is the comparatively slow-speed Diesel oil engine that is to form the main theme of most of the remarks that follow ; such an engine, indeed, as is well illustrated in the photo., Fig. 1. The illustration shows a single-cylinder horizontal Diesel oil engine of the kind manufactured by Messrs. Crossley Bros., the well-known and old-established gas and oil engine makers of Openshaw, Manchester. The horse-power developed would range from 10 to 120, and the r.p.m. from 220 to nearly 500, perhaps.

One's desire would be to undertake the making of a small-scale working model of this fine-looking engine—the cylinder diameter of the model being no more, perhaps, than 1 in.—or even less. One's desire would be to reproduce all the interesting features of the engine—the side shaft, the governor, the exhaust and the air-valve mechanism, the fuel pump, and even the atomiser, in a perfection of finish and an accuracy of scale. How frequently in the past has this kind of desire taken possession of one—the perfect working model of the gas engine, the oil engine, the Diesel engine. But, unfortunately, all such desires are totally incapable of fulfilment, and particularly so in the case of the engine last mentioned—the *Diesel* engine.

Some Difficulties

It may be interesting to point to a few of the difficulties which would need to be overcome in any attempt to reproduce the engine illustrated in model dimensions. It is feared that the only word justly applicable to the attempt is one which the average engineer dislikes—*impossible*.

The modern Diesel engine is no longer dependent upon an *air blast* to spray the oil fuel into the combustion chamber—a fact which will be well known to many of you. But the pump whose duty it is to deliver the oil under extremely high pressure to the " sprayer " or " atomiser " is a sufficiently difficult piece of skilled workmanship, even when such pump is applied to an engine with a 10-in. or 12-in. cylinder. Can one imagine the difficulty of making this kind of pump, with its suction, delivery and " spill " valves, adapted for use on an engine having a piston diameter of not much more than 1 in. perhaps. It would seem like an impossibility, even on a mass-production basis, with all the necessary tools available, and in an ultra-modern engineering workshop. What a problem, then, for the amateur to tackle ! But there is a further stumbling-block—another item of still greater constructional difficulty to tackle. The oil is sprayed and finally delivered into the highly compressed air of the combustion chamber by an " atomiser." This atomiser consists of a spring-controlled spindle having an inner end of valve formation seating upon a cylindrical plug. The spindle-valve is pressure-opened. The inner end of the spindle usually controls a few holes of most minute dimensions. The drilling of these holes requires the services of a specially designed drilling machine, special drills and special skill. Thus, one may, in considering the possibilities of an atomiser in miniature, quite reasonably apply the word *impossible*. So much, then, for purely constructional difficulties.

Perhaps there are even more important considerations to be discussed and considered when balancing up the possibilities of the small oil engine of no more than model-engineering dimensions. Be it remembered that the pressure of compression in the combustion chamber, prior to fuel injection, must necessarily be a very high one—2,000 lb. per sq. in. perhaps. (The kind of compression pressure usual in the petrol engine is quite inadequate to give automatic ignition.) How can such a pressure be maintained when diminutive piston, piston rings, cylinder and valves are each one of them exposed to it ?

A Heat Problem

But we are faced with still another problem, and this time it is a *heat* problem. It is only necessary to refer to a few tables of areas and circumferences of circles to arrive at mathematical proof that the proportion of surface to cubic contents is much greater in the case of a small cylinder and combustion chamber than it is in that of a large one.

In other words, the *small* cylinder has a much greater proportion of surface for *heat dissipation* than the large one. And this is the kind of mathematical certainty that can by no means be overcome. Once again, then, can it be stated that, to secure spontaneous ignition by the high temperature of compressed air in a cylinder of say, 1 in. in diameter and proportionate stroke, is not a possibility. The serious heat loss is a problem that *cannot be effectively dealt with*. It is to be feared that the foregoing remarks are of an entirely negative character. It seems to have been proved in the Q.E.D. manner of our old informative friend Euclid that the problem cannot be solved, or rather that its solution is of a negative character. Thus, it must be, unfortunately, maintained that *the small dimension Diesel oil engine can never materialise*. Thus, is one led to search for other means for the construction of a small engine, having at least *some* of the characteristics of the engine depicted in Fig. 1, and perhaps a fair proportion of the appearance of this rather attractive engine. There seems to be more than one solution.

Information from Small Model Gas Engines

Some considerable number of years ago, before the present calamitous war, and even earlier than the 1914-18 struggle, a certain Continental maker (one does not feel inclined to mention by name the country referred to), placed upon the market some small model gas engines. These engines were all of non-compression type, and were really very well made —and they worked remarkably well, too. The engines were made in three sizes, the smallest having a cylinder composed of steel tube, and the two larger having cast ribbed cylinders—such as are fitted to the modern cycle engine. (One of the small engines was—and perhaps is still—on view at the Science Museum at South Kensington as part of a large factory or similar model.)

Flame Ignition

A few other details of the engines will be referred to later, and in the meantime it is necessary to draw attention to the igniting system, for this same system may well be applied to any small model internal combustion engine operating without compression.

Fig. 2 is a section through the cylinder, taken at a point at which the piston has accomplished about one-third of its stroke. It will be noticed that a small perforated plug is screwed into the cylinder casting, and that a gas jet, fed by a pipe in connection with the gas supply burns in close proximity to the plug. Slight suction effect caused by the outward movement of the piston drew the flame into the cylinder and explosion ensued. There was a chimney immediately over the gas flame, partly for purposes of realism and partly by causing a slight upward draught, to

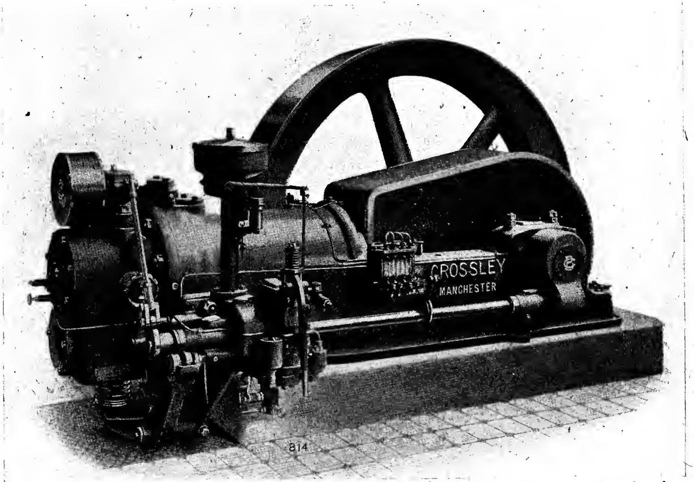


Fig. 1. Crossley horizontal Diesel engine—H.D. type—showing some of the more important external features of the engine—the governor, the fuel pump, the exhaust and air valve operating mechanism, the air silencer, etc. (Photo. courtesy of Messrs. Crossley Bros., of Openshaw, Manchester.)

ensure a steady igniting flame. In addition to all this, there was a piece of wire gauze disposed opposite the firing port, its purpose being to prevent the possibility of fire due to flame projection when explosion occurred.

Since at the moment of explosion the cylinder was open to the atmosphere, naturally these engines were noisy, and successive explosions produced an effect something like this—pap-pap-pap-pap-pap. These sounds, indeed, completely drowned other slight mechanical noises which one would normally expect.

There was another peculiarity which is worthy of comment. No oil was used for the lubrication of cylinder and piston, but instead powdered graphite was fed into a small cup screwed into the cylinder. The effect of this graphite was to almost entirely eliminate friction, so much so, that, after cutting off the gas supply, the engine would continue to run for a quite considerable time. (When put to the test, an engine owned by the writer refused to work when lubricated with *oil*.) Perhaps this is a valuable hint for prospective makers of very small gas engines.

Since the chimney shown in Fig. 2 need not have a diameter of more than $\frac{3}{8}$ in. and a height of more than 1 in., the little device is not unsightly. It could, indeed, be embodied quite satisfactorily in an engine of small dimension and without interfering seriously with the sundry interesting parts to be seen in Fig. 1.

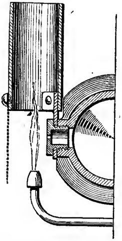


Fig. 2. Flame ignition as applied to a small model non-compression gas engine. Illustration shows section through cylinder.

The above remarks are intended to point to the possibility of building quite a nice little scale model of an oil engine—provided that *compression is dispensed with*. But there is another, and some may think better, method of tackling the problem, and this method, devised by the writer of this article, is described and illustrated rather fully in the paragraphs that follow.

A Proposal re a Small-scale Model Diesel Oil Engine

Earlier in these notes it has been pointed out that the superlatively high compression of the Diesel engine method and the essential high pressure pump and atomiser, together render the modelling of such engines a sheer impossibility. Well, so much for that. Now, supposing that instead of introducing the enormous compression and explosion pressure of such engines with all the attendant difficulties, we were to content ourselves with much *lower* working pressure. And supposing we were to heat and expand the working fluid—air—in a separate vessel instead of in the back end of the cylinder itself. Then we should obviously have a proposition of a very much more simple nature. The complicated pump and atomiser would be replaced by a simple external heating device. Indeed, all manufacturing difficulties would seem to vanish into thin air by this simple expedient—that of heating the working fluid in a separate chamber by means of heat applied to its exterior, instead of performing this process *in the engine cylinder itself*. The method proposed does not make for economy, neither will it yield so much power—but what matter. The main purpose of a working model is that it should be a going concern. The reader will perhaps desire to interrupt here with some such remark as "this is nothing new that you are describing—this is quite clearly the working method of the hot-air engine, slightly dished up so as to disguise it—nothing new at all!" Well, it is precisely the *principle*—of the simplest and best known type of hot-air engine, that it is the intention of the writer to call to his assistance in the production of what he thinks should prove a satisfactory little model of a Diesel oil engine.

There is, indeed, some slight characteristic resemblance between the oil and the air engine. Both are *heat* engines. Both are operated by the expansion of a working fluid. Both may be put to work in a couple of minutes. Both perform their work for a long period without attention. And finally, both need to be started by external means.

Now, as part of the hot-air engine system, a word regarding the "displacer." The displacer is a somewhat unsightly and bulky piece of apparatus, and it has, indeed, no counterpart in the oil engine. It must, therefore, be camouflaged or concealed so as to be out of sight—and thus too, may it be almost out of mind.

In each of the three schemes described and illustrated hereafter, the displacer is tucked away beneath the engine room "floor," and the means employed to operate it is, as well as may be, hidden from view.

Hot-air Engines

It is perhaps unnecessary to discuss the principles embodied in the working of the hot-air engine, for the reader has nought else to do but refer to back numbers of THE MODEL ENGINEER, dated September 12th, October 24th, and December 5th, 1940. In the issues referred to will be found a most comprehensive and informative series of articles by "Artificer"—a really excellent little study of the history and development of this most interesting form of heat engine.

One particular type of engine, however, must have special reference in these notes—the Robinson engine described and illustrated on pages 207 and 208 of the September 12th, 1940, issue of the "M.E." In this engine the movement of the displacer is derived from a rocking beam receiving its motion from the crankpin of the engine. Since the axes of the working cylinder and of the displacer are at right-angles to one another, both can be operated from the *same* crank-pin. (If displacer and cylinder have parallel axes, as is more usual, then the operating cranks must, of course, have a 90-deg. interval.)

Now for the purpose of the scheme which the writer is putting forward in a suggestive, and it is to be hoped, practical manner, the motion of the displacer might just as well be obtained *direct* from the crank-pin—without the intervening link system. In this manner it is possible to locate the displacer chamber, so as to be entirely out of sight and at the same time to render the light connecting-rod for reciprocating the displacer itself conspicuously inconspicuous—if one may be permitted so to express oneself.

(To be continued)

★ Small Capstan Lathe Tools

Notes on "tooling up" for repetition work, with special application to the small capstan attachment recently described in the "M.E."

By "Ned"

Chucking

THE form of chuck employed for capstan lathe work has an important bearing on the facility and speed of handling the work. No form of chuck can be ruled out as absolutely unsuitable; when dealing with awkwardly-shaped castings, a four-jaw independent chuck may be very useful or even indispensable, but the time taken in setting up the work in this type of chuck can ill be spared when handling round or symmetrical work. This can usually be dealt with much more expeditiously in a self-centring chuck, but for small bar work which will pass through the mandrel of the lathe, a collet chuck is strongly to be recommended. Many small lathes are fitted with socket adaptors to take standard "pull-in" collets, but the usual type of 3 in. lathe with a mandrel having a ⅜ in. hole through the bore will only take an 8 mm. (A size) collet, the largest "through" bore of which is only about 3/16 in. Thus, only very small bar work can be handled by this type of chuck.

Larger collets can be accommodated by using an external adaptor screwed on the mandrel nose. An excellent adaptor of this type was described some time ago by Mr. Ian Bradley. It should, however, be noted that in any case where the collets are pulled through the mandrel by a draw spindle, it is impossible to utilise the full bore diameter of the mandrel, and in practice, the largest size of work which can be taken by a ⅜ in. bore mandrel is about ¼ in. The only way in which bars up to the full bore diameter can be used is by using either a jaw chuck or a collet chuck of the "push-in" type, closed by means of a ring nut over the nose adaptor. A simple form of this chuck was shown in the article dealing with the conversion of a small lathe to vertical milling, published about two years ago in THE MODEL ENGINEER.

The outstanding advantage of a split collet chuck over the jaw type is that it can generally be guaranteed to hold the work true within very close limits, and this may be a very important advantage when dealing with bar work, in which the necessity for machining all over arises only when concentric accuracy must be corrected. Many parts, such as screws, studs, nuts, nipples, etc., can only be made economically by using bar of the exact diameter of the largest portion of the component, and running it truly, so that external machining is dispensed with. This applies even more strongly when hexagonal or other special section bar is used, as the external machining to the required shape and accuracy would be very laborious and expensive. It is thus profitable to take every care to ensure that chucks run perfectly true, or to construct special chucks or other fixtures whereby the true mounting of work can be facilitated. Time spent in this way is never wasted, as these appliances are invaluable in general turning practice, quite apart from their application to repetition work.

Jaw chucks can often be adapted to quick and accurate chucking by the attachment of soft pads or jig blocks to the jaws. An old and worn self-centring chuck may have the jaws softened and the steps cut away, mild steel blocks then being firmly attached by screws, and then machined in place to suit the particular work to be handled. Even if the scroll of the chuck is strained or worn out of truth, it will hold the work dead truly so long as it does not have to accommodate varying diameters.

If a number of irregular-shaped parts have to be held, a four-jaw chuck can be adapted as a rapid chucking jig by removing three of the jaws and replacing them with one or more blocks shaped to fit the component (Fig. 1). The one remaining jaw is then used to clamp the latter firmly against the blocks; some kinds of work may demand the use of two adjustable jaws, but the advantages of using only one wherever possible will be obvious.

It is obviously impossible to explain or illustrate the design of fixtures necessary to deal with every type of component likely to be handled, and the example illustrated is intended only to show the principle. Many cases arise in practice which call for some ingenuity in the design of chucking fixtures, but there are few problems of this nature which cannot be solved by careful thought and practical common sense.

Other chucking fixtures to hold various kinds of work, such as parts which have to be held by a previously-machined surface, which is at an angle to the required centre, eccentric, or screwed, may also be made up and attached to the chuck of faceplate. As to the amount of trouble to which it is advisable to go in making these fixtures, much, of course, depends on the quantities of components to be handled. While it would not be worth

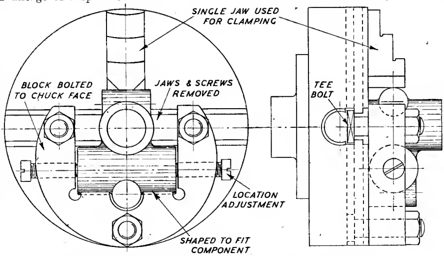


Fig. 1. An example of how the four-jaw chuck can be adapted as a chucking jig for awkwardly-shaped components.

* *Continued from page* 256, "*M.E.*," *September* 25, 1941.

while to make an elaborate fixture to deal with one or two dozen parts, almost any trouble would be worth while if the number of parts runs into thousands.

The reliability and security of any chucking device used for capstan work must be beyond question. Nothing wastes time worse than a chuck which slips during a heavy machining or screwing operation, and in some cases either the work or the tool may be spoiled by a mishap of this nature.

When handling bar work of too large a diameter to pass through the lathe mandrel or chuck, it is, of course, necessary to saw the parts to a suitable length for chucking. It is sometimes possible to save both time and material in such cases by "double-ending"—that is, by cutting each piece sufficiently long to make two parts, and machining one end of a batch first, then reversing (in a special chucking fixture if necessary) to machine the other end and part off.

Work Stops

When working with long bars, which are fed through the chuck as each piece is completed and parted off, the first capstan tool which must be brought into action is the

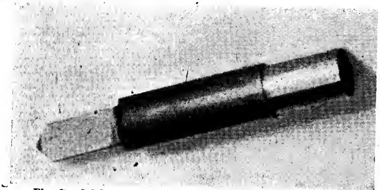


Fig. 2. Solid spear-point drill made to fit the capstan holder for centre-drilling.

"work stop." This consists simply of a flat-ended abutment, which at the forward limit of the capstan slide travel, is brought into such a position that it forms a gauge for the length of bar required to project from the chuck for making a single piece. Any piece of steel rod, turned to fit the capstan holder socket and faced off truly on the front end, may be used for a work stop, but it is an advantage to case-harden the face if it is intended to use it for a large number of parts. Special work stops having ball or roller thrust bearings are often used in production practice, where the chucks are automatic and the work is fed up against the stop while rotating at full speed; but the necessity for such elaborate fittings does not arise in the case under discussion.

The position of the stop is adjusted by means of the appropriate capstan slide end stop, or by moving it in and out of the holder socket. It is usually the first tool to be adjusted, and the positions of other tools, both in the capstan slide and the cross slide, are related to it. To use the stop, it is advisable to push the work through the mandrel a little further than is required, and partially tighten the chuck. The capstan slide is then brought forward to the limit of its travel, so that the work is pushed back into the chuck by the work stop; after which the chuck is fully tightened, and machining commenced.

It will often be found, when using collet chucks, that the action of drawing up the collet to tighten it will slightly withdraw the work from the stop, and thus affect accuracy in respect of length. Allowance may be made for this when setting the stop, but where exact accuracy is necessary, a more reliable method would be to allow for machining the end of the work by means of a facing or end-forming tool. The length of screws or bolts is sometimes adjusted by means of a stop fitted to the turning or "running-down" tool holder, in which case, any error in the action of the ordinary work stop would affect the length of the head, instead of the shank.

Facing

Bar work, which is cut off by means of a parting tool when completed, does not ordinarily call for a facing operation, because the surface left by the parting tool is, or should be, sufficiently true and smooth for most purposes. When starting work on a new bar, therefore, it is generally necessary to part off a short length so as to provide an accurately faced end to make contact with the stop, and form the end face of the new piece. The setting of the parting tool is of high importance in this respect, and will be dealt with in its appropriate section.

Facing operations are, however, necessary in some instances in bar work, and invariably so when machining castings and forgings. The facing tool is sometimes mounted in the cross slide, especially when a tool-post turret is employed; but more often it is used in the capstan-head, and in order both to save time and economise in the use of the capstan stations, it is usual to combine it with another cutting tool, such as that used for centring or end-forming.

Centring

Quite a large proportion of the work carried out on capstan lathes calls for internal drilling or screwing, and in such cases the forming of an accurate centre to start the drill is a very important operation. The drill used for this purpose should be held in the capstan socket as rigidly as possible and should not project farther than is necessary. A Slocumb type of centre-drill, fitted to a short stub holder, may be used for this purpose, but its comparative fragility, and the difficulty of re-sharpening it after the point has become dull, are disadvantages. It is often stated that the acute angle of the countersink formed by a centre-drill is unsuitable for starting a drilled hole; but the writer considers, on the contrary, that this is actually helpful in keeping the lips of the drill central before the point (which is always the least efficient part of the cutting edge) begins to cut. Be that as it may, however, it is more common to use a form of drill which is more easily set and sharpened in the present case. A flat spear-point drill such as that shown in the photograph (Fig. 2) may be made from silver-steel to fit the capstan holder, and combines the utmost rigidity with reasonable cutting efficiency. It will be seen that the extreme tip of the drill is ground off to a diamond point; in this way the indentation made is sufficiently sharp for starting the smallest drills.

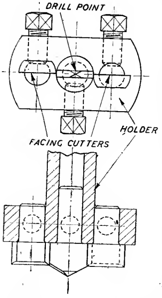


Fig. 3. A combined centring and facing tool holder for inserted cutters.

(*Continued on page* 296)

★ The Construction of A Reflecting TELESCOPE

By W. E. Moorhouse, A.M.I.M.E.

THE whole mounting should be turned and screwed in a lathe, care being taken that no play takes place when part *A* is screwed into part *B*, but it should be slack enough to enable it to be screwed in and out by hand. Part *B* may now be fixed to the barrel, exactly central and opposite the small flat mirror, by means of three 3/16-in. screws and nuts, as shown in Diagram 21.

Many telescope makers may decide to buy the first eyepiece, so that the telescope can be used whilst further eyepieces are made at leisure. In any case, the following details will enable eyepieces to be constructed for various magnifications, but it will be an advantage if I explain what is meant by magnification. In the earlier part of this article, I said the telescope had a magnification of 200. This means that the telescope will magnify a distant object to 200 times its apparent size; in the case of a round objective, such as the moon or the stars, it will magnify the diameter 200 times. The magnification obtained from any telescope depends on two things; the focal length of the mirror and the focal length of the eyepiece. When these two focal lengths are known, the magnification may be found by dividing the focal length of the mirror by the focal length of the eyepiece; or,

$$\text{Magnification} = \frac{\text{Focal length of mirror}}{\text{Focal length of eyepiece}}$$

But in this case we know that the focal length of the mirror is $52\frac{1}{2}$ in., and, if we settle the magnification figure, we can find the necessary focal length of the eyepiece.

Three eyepieces, at least, should be made, as follows :—

(*a*) One having a low power, and thus showing a large area of sky. For this I suggest a magnification of 8 per inch diameter of mirror, which in our case will give a total magnification of $8 \times 6\frac{1}{2}$ = say $52\frac{1}{2}$.

(*b*) One of moderate power, about twice the magnification of (*a*) = say, $2 \times 52\frac{1}{2} = 105$.

(*c*) One of high power, having a magnification of four times that of (*a*) = say, $4 \times 52\frac{1}{2} = 210$.

* *Continued from page 272, "M.E.," October 2, 1941.*

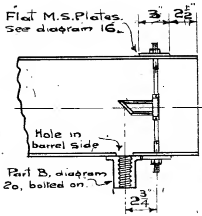


Diagram 21. Position of eyepiece mounting on barrel.

As we now know the required magnification of the telescope, and also the focal length of the large mirror, which is fixed, we can calculate the necessary focal lengths of the eyepieces to give the above magnifications.

$$\text{As magnification} = \frac{\text{Focal length of mirror}}{\text{Focal length of eyepiece}}$$

Then

$$\text{Focal length of eyepiece} = \frac{\text{Focal length of mirror}}{\text{Magnification}}$$

Thus for (*a*).

$$\text{Focal length of eyepiece} = \frac{52\frac{1}{2}\text{ in.}}{52\frac{1}{2}} = 1\text{ in.}$$

For (*b*).

$$\text{Focal length of eyepiece} = \frac{52\frac{1}{2}\text{ in.}}{2 \times 52\frac{1}{2}} = \tfrac{1}{2}\text{ in.}$$

For (*c*).

$$\text{Focal length of eyepiece} = \frac{52\frac{1}{2}\text{ in.}}{4 \times 52\frac{1}{2}} = \tfrac{1}{4}\text{ in.}$$

There are two common forms of eyepiece, the "Ramsden" and the "Huyghenian," but I intend to describe the latter only. Diagram 22 shows the construction of this eyepiece, which consists of two plano-convex lenses with the flat side of each lens towards the eye. The ratio of the focal lengths of the two lenses should be in the ratio of 1 : 3, separated by a distance of 2, which means that if lenses of 1 in. and 3 in. focal length are used, their distance apart should be 2 in.

The formula for finding the equivalent focal length of these eyepieces is as follows, the

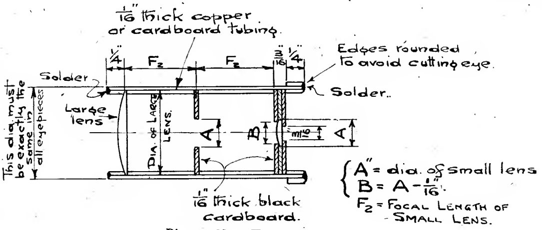


Diagram 22. "Huyghenian" eyepiece.

equivalent focal length, being the resultant focal length of the eyepiece, when using two lenses of different focal lengths.

$$\text{Equivalent focal length} = \frac{F_1 \times F_2}{F_1 + F_2 - A}$$

where F_1 = focal length of one lens.
F_2 = focal length of other lens.
A = distance apart of lenses.

In our case, the lowest-powered eyepiece has an equivalent focal length of 1 in.

$$\text{Therefore } 1 \text{ in.} = \frac{F_1 \times F_2}{F_1 + F_2 - A}$$

But $F_1 = 3F_2$
and $A = 2F_2$

So, if we substitute $3F_2$ for F_1
and $2F_2$ for A in the above formula,

$$\text{We get } 1 \text{ in.} = \frac{3F_2 \times F_2}{3F_2 + F_2 - 2F_2} = \frac{3F_2{}^2}{2F_2} = \frac{3F_2}{2} = 1\tfrac{1}{2}F_2$$

$$\text{Thus } F_2 = \frac{1 \text{ in.}}{1\frac{1}{2}} = \frac{2 \text{ in.}}{3}$$

$$\text{and } F_1 = 3F_2 = \frac{3 \times 2}{3} = 2 \text{ in.}$$

$$A = 2F_2 = \frac{2 \times 2}{3} = \frac{4}{3} = 1\ 1/3 \text{ in.}$$

Thus, for an eyepiece of 1 in. equivalent focus, we require two lenses, having focal lengths of 2 in. and 2/3 in. respectively, and their distance apart must be 1 1/3 in.

Similarly, for an eyepiece having an equivalent focus of ½ in., the separate lens must have focal lengths of 1 in. and 1/3 in. respectively, and their distance apart will be 2/3 in.

For an eyepiece having an equivalent focal length of ¼ in., the separate lens must have focal lengths of ½ in. and 1/6 in. and a distance apart of 1/3 in.

For the above eyepieces, spectacle lens and smaller magnifying glasses will be found suitable, and a friendly optician will probably be able to find those required and supply very cheaply. By using copper tubing, or even stiff cardboard tubing, the eyepieces may be made as shown in Diagram 22.

The parts now made will enable the telescope to be finally assembled, when it will appear as shown in the photograph of the finished instrument. A small flap door will be noticed, and I consider that this is well worth while, as, after using the telescope, any dew which has collected on the large mirror, can be soaked up through this flap door, doing away with the necessity of dismantling the mirror housing. This prevents the mirror tarnishing, and it is recommended that a pad of cotton wool be obtained, and placed over the large mirror, when not in use, this pad being held in place by means of two spring clips fixed to the part *B* of the mirror housing. Mirrors should never be wiped, as even the softest cloth will scratch the silver reflecting surface. The pad of cotton wool, placed on the mirror is sufficient.

For those who wish, I suggest that a finder be fixed to the barrel. This consists of a small telescope, and may be made from two small object glasses, fixed in a tube, and enables an object to be found quickly, being most useful with high-powered eyepieces as, due to the large magnification, the object quickly passes across the field of vision, and in the case of small objects, may be difficult to find in the telescope.

When completely assembled, the instrument requires adjusting before being ready for use. This should be done as follows :—Take out the eyepiece and look through the bore of the eyepiece mounting, when the reflection of the large mirror should be seen in the flat mirror. If this is not so, adjust the large mirror by means of the four ¼-in. dia. bolts, holding the mirror housing to the barrel, and slackening or tightening to suit. When this has been done, replace eyepiece, and three concentric circles should be seen, the outer circle being the large mirror, the centre circle being the flat mirror, whilst the small inner circle is the eyepiece. Until all these circles are exactly concentric, no image will be possible. Adjustment of both large and flat mirrors may be necessary to obtain perfect concentricity. The other adjustment needed is to obtain a correct focus, which can only be done under actual viewing conditions. This will probably be managed by screwing the eyepiece mounting in or out of its slide, so that the exact focal length is obtained, the clearness of the image being a reliable guide, when approaching the correct position. If this does not give the desired result, the large mirror will require adjustment along the length of the barrel. These adjustments are, of necessity, correctly accomplished only by means of trial and error methods, but only need doing once.

After viewing through the telescope such things as the mountains of the Moon, or Saturn's rings, all the trouble and time spent on making the telescope will be felt to have been worth while, as they appear literally to come to life, and it is seen that they are solid worlds similar to our own, instead of flat, uninteresting bodies, as seen with the naked eye.

Small Capstan Lathe Tools

(*Continued from page* 294)

Short lengths of twist drills, fitted in suitable stub holders, may be used for centring. It is not, however, advisable to use a drill much smaller than ¼ in. diameter in this way, as its rigidity may be dubious. In no case should a centring drill be fitted to a drill chuck, or allowed to project a long way from the capstan socket. If the alignment of the capstan slide is inaccurate, it may be found advisable to grind the point of the drill off centre, so that it definitely finds the centre of the work, and does not scribe a circle on it when it first makes contact.

Fig. 3 shows a simple form of combined centring and facing tool which can be made up to suit the class of work in hand. It comprises a holder which carries three bits turned from silver-steel and held in place by set-screws. The centre bit is shaped to form a drill point, and the other two, which constitute the facing cutters, are ground or filed half away, like D-bits. If they are to be used on steel, these faces can be given top rake ; a clearance angle is, of course, provided on the front face. When these bits are made or subsequently reground, great care must be taken to set the faces absolutely dead square with the axis of the holder, and projecting equally from the face of the latter. The drill point is shown with its flat face in line with the plane of the cutting edges for convenience in drawing, but it is really preferable to set it at right-angles, as this allows of making the edge sufficiently broad to overlap the path of the facing cutters slightly, and thus ensure that the entire surface of the work is properly machined. This form of tool may be used for facing only, or centring only, by removing the cutters not required ; and it is also adaptable to bevelling and end-forming operations by modifying the form of cutter. Generally speaking, tools with inserted cutter bits such as these are preferable to solid tools, as they are much easier to sharpen and re-set, besides being much more adaptable to varying requirements.

(*To be continued*)

Workshop Problems Solved

A solution to "snags" which beset all model-makers

By R. H. Morrell

HUMAN ingenuity is a very astonishing and prolific thing, and literally thousands of clever methods have been devised to overcome the many snags which arise in model-making and model engineering generally.

One is constantly reading in technical journals of problems which have confronted readers, and of the manner in which they have been successfully overcome. These workshop methods and hints on various subjects are constantly being given in THE MODEL ENGINEER and other journals, such as the American "Popular Mechanics" and "Popular Science," and as one reads such journals many ideas occur which are of direct interest to oneself.

I think everyone endeavours to make a mental note of all these interesting methods and recipes, but, unfortunately, the amount of matter which the human brain can store and reproduce on demand is definitely limited, especially so in difficult times like the present when there is so much else to assail our intellects.

Unfortunately, but inevitably, this results in many valuable ideas being lost to one's memory for ever and many more are retained only partially, some major factor frequently being forgotten, thus nullifying the value of the idea. How many of us have not pondered over some half-remembered method of doing a special job and thought, "Where did I read of that?" Perhaps one knows that a method was described in THE MODEL ENGINEER, but cannot remember the number of the volume in which it appeared, and has no idea of the article's heading. The only course then open is a long page-to-page search through several volumes which, although a very interesting occupation in itself, is not desirable when one is in the middle of a job of work, and is calculated to slow down "production" in an appalling manner.

Having pondered over these matters, as all model engineers delight to ponder, I decided several years ago to endeavour to overcome this problem of "wasted knowledge." The result of this cogitation was the commencement of a book in which all interesting ideas, methods, recipes, etc., were to be written down and thus stored so as to be permanently available as and when required. This idea has been conscientiously carried out, and in consequence I already possess a valuable book of reference which offers most helpful advice on a great number of workshop methods and recipes, and which is, in fact, a "Workshop Encyclopaedia." Furthermore, the book will continue to grow and will, I feel sure, eventually become one of my most useful possessions.

To convey some slight idea of the amazingly diverse ideas, methods, and recipes, all most helpful, which one quickly accumulates, I am giving a few headings picked at random from my book :—

Blackening Brass (various methods).
Making Gas Blow-lamps.
Lapping-out Cylinder bores.
Making Small Lathe Tools.
A Super-sensitive Drilling Machine.
Making Model Boiler Fittings.
A Cutting Oil for Aluminium.
Improving a Cheap Lathe.
Frosting Metal Surfaces.
Drilling Holes in Glass.
Cutting Keyways.
Making an expanding Lathe Mandrel.
A Slide-rest Tool for Wood.
Making a Bench Filing Machine.

These are only a few of the subjects covered, but give some idea of the possibilities of such a reference system. Of course, some of the subjects in my book would not be required by some other model engineers, but anyone adopting the idea would naturally select for inclusion in his book only those ideas kindred to his own interests and likely to be of value to him.

To commence the system, a good stiff-covered book with an index must be procured, and if the pages are not already numbered, this must be done. As each selected item is entered in the book, it must also be entered in the index immediately, or it may be forgotten. As some of the matter may be required for reference a long time hence, it is obvious that careful and accurate indexing is of great importance, otherwise the book will lose much of its value.

I adopt a careful system of cross-indexing which makes it easy to pick out any desired item, when required. As an example, let us take the heading "Wood-turning tool for Slide-rest." I should index this under "S," "T," and "W" as follows :—

S. Slide-rest tool for wood turning. Page 9
T. Tool, Slide-rest, for wood turning. Page 9.
W. Wood-turning tool for Slide-rest. Page 9.

I consider the slight extra work involved well repaid by the convenience of reference obtained.

Many short items are simply copied out verbatim into my book and suitable sketches provided ; in some cases where the journal will not be kept, it is convenient to cut out the article and paste it into the book intact. It will be seen that as many required descriptions are of considerable length, writing them out would be rather strenuous and may be quite unnecessary. The main point is whether or not the journal in which the required information has appeared is one that will be kept and always available. For instance, I do not attempt to copy out any long description appearing in THE MODEL ENGINEER, as my volumes are always at hand, and in such a case, I merely make an entry in my book as follows :—

A Super-sensitive Drilling Machine

For drilling very small holes down to .1 m/m. using watchmakers' drills. For full constructional details, see THE MODEL ENGINEER, Volume 74, page 102.

The point to grasp is that the book is not purely a source of information, but also a "key to information," and as long as it directs the reader to the source of the solution of a problem it fulfils its objective.

In the case of information appearing in a book which is borrowed or will not be kept, it is necessary to copy out the required matter, but even so it can frequently be considerably abbreviated without robbing it of its usefulness.

I have already spoken of the inclusion of sketches in the book, and it will be seen that these have great value in making a description clear, especially where the article refers to parts of a drawing and mentions them alphabetically. Unfortunately, the copying of a complicated sketch (which probably includes screw threads) is rather laborious if proportions are to be carefully preserved, but it is easy to avoid this difficulty. I keep a stock of thin white paper,

(Continued on next page)

An Angle Gauge for Setting Threading Tools

WHEN setting-up tools for cutting threaded workpieces in the centre lathe, some difficulty is usually encountered in *accurately* and *quickly* setting the single point threading tool at the *correct angle* with the workpiece.

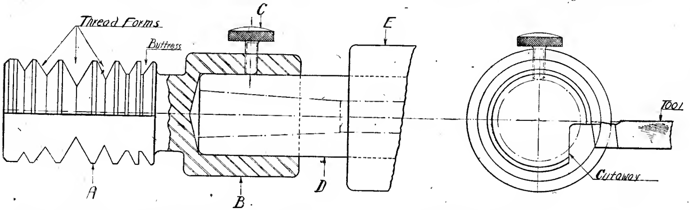
In order to overcome such troubles the writer has made up and used for a considerable period the very simple, inexpensive, yet most useful type of tool-setting gauge here illustrated. Its introduction speedily led to a complete elimination of all tool-setting troubles aforementioned.

end view, but preferably be left about ⅛ in. below the centre, so that a fuller engagement of the tool is ensured.

The gauge may be made up, having any number or shape or size of thread grooves to suit user's requirements.

To set a threading tool, the gauge is first located and locked on to the tailstock spindle, *D*, the tailstock, *E*, being also clamped down on lathe gantry. The threading tool is then lightly gripped in toolpost, and the cross and saddle slides then adjusted until the tool enters the appropriate groove. The screw holding the tool should then be released, so that, as the tool is moved further within the groove, it may be free to move round to align itself correctly, whereupon it is firmly clamped to toolpost, and thus be ready for commencing the threading operations.

A further refinement and advantageous feature which



Referring to the reproduced diagrammatic view, it will be seen that this gauge comprises a length of cylindrical mild steel rod, *A*, into which are turned a series of concentric grooves, the sides of which conform exactly with definite thread angles likely to be used. The rod is then cut away by means of a right-angled slot, as is shown clearly in the end view at the right hand.

The rod, *A*, is provided with a hollow extension-piece at its right-hand end, as at *B*, this being of slightly larger outside diameter than the front portion, and bored out parallel for a short distance, so as to be a snug push-on fit over the end of tailstock spindle, *D*. It is secured tightly to this spindle by means of the brass knurled-headed locking-screw, *C*, which passes through a threaded hole machined in the wall of sleeve portion, *B*.

The right-angled cutaway portion should not extend above centre line of gauge, as shown at the right-hand

will aid quick setting is to stamp a size, or other identification mark for each groove on the gauge. Furthermore, the solid-grooved end of gauge may usefully be case-hardened, so as to obviate the danger of raising bruises or burrs as a result of a cutting tool being inadvertently jammed too forcibly into the thread groove. Care will need to be taken during this hardening operation, otherwise some distortion may arise which will lead to errors in setting.

Where a large number of thread grooves are provided in gauge, *A*, this may cause undue overhang from tail spindle, which again may lead to error. To avoid this, a centre hole should be provided on left-hand endface of *A* and a hardened centre-bit inserted into the live spindle of lathe for engagement with the gauge before final clamping of the latter to tailspindle. Thus, the gauge will be prevented from moving away from tool, as this latter is being fed into position.—W. M. H.

Workshop Problems Solved

(*Continued from previous page*)

such as is used in offices for typewritten carbon copies, and this is reasonably transparent when held firmly against a printed illustration. It is a simple matter to trace off the required diagram on a sheet of this paper which is then trimmed to a suitable size and pasted into my book to illustrate the article referred to.

Although I adopted a book as my system of filing, an alternative method has occurred to me and some readers might prefer it. I think it would be quite a sound idea to run a card index system with cards of reasonably large size, say about 5 in. by 3 in.

I would suggest numbering each card numerically and employing a separate card for each item. Details would be entered on the card and sketch-tracings gummed on just as in the case of a book. The cards would be kept standing vertically in a box of suitable size, and a set of index cards would be kept at the front of the box. Between each of these would be a number of cards bearing the titles of the various items and showing the number of the card to be consulted for that item.

Personally, I prefer the book system as being more compact and as obviating the possibility of lost cards, but the card index idea may appeal to some readers.

One word of advice I would proffer is—do not have your book or card tray too small. It is surprising how information accumulates, and as the system will be in use for years, have a system that can continue to expand without having to overflow into a second volume. If any readers decide to adopt this system of storing information, may I suggest that they not only jot down items that interest them from now on, but also look back for ideas already gained but now half forgotten.

In conclusion, I hope that this article may inspire the creation of a number of "Workshop Encyclopaedias," which will eventually become treasured possessions.

Letters

The "Gearless" Car

DEAR SIR,—I was very interested to see the reference to the "Gearless" car in recent issues of THE MODEL ENGINEER. I believe the car referred to was on exhibition at the British Empire Exhibition at Wembley. To the best of my recollection, it was powered by a "Villiers" 2-stroke engine (with flywheel magneto) of about 2¾ h.p. Although "gearless" in the sense that no manual selection of gear was needed, there was a system of infinitely variable gearing controlled by the loading on the engine. It operated by centrifugal action, and was a "Constantinesco" patent. I should imagine the engine worked at constant speed. Although not as yet an I.C. fan, I have been very interested in the series of articles on this subject, and when this "spot of bother" is over, I may strike out in this direction, when these articles will come in very useful.

Yours faithfully,

Halling. R. J. BURR.

DEAR SIR—Referring to Mr. Westbury's article in the September 6th issue of THE MODEL ENGINEER.

I am not quite sure which was actually called the "Gearless" car because round about the period mentioned there were several cars which could lay claim to that title. There was certainly a car on the market called the "Valveless."

The Gearless cars I have in mind were those actually seen by the writer at the Motor Show (*circa* 1912-1913), and they were "The Crown Magnetic," the "G.W.K." and the "Lentz."

The Crown Magnetic was really a gearless car in so far as no gearbox was incorporated in the transmission. The flywheel of the engine was really a rotating field magnet of a dynamo or, shall we say, it was a dynamo with the armature rotating round the exterior of the field. Imagine two dynamos directly connected together in line mechanically, the field of one being the engine flywheel and the field of the other being the gearbox, the two armatures being connected *via* propeller shaft to the diff. in back axle. You can visualise the sequence of electrical events. The car was very successful and a *non-skidder*, but I believe the price was against it.

The G.W.K. was a friction-driven car, and one of the few which was really a success. This was driven by a *two-cylinder engine*, I believe, it being stated at the time that a single-cylinder engine was not successful with the type of transmission used.

The Lentz car was exhibited as a chassis at the show, and was the patent of Dr., or Professor, Lentz, of Germany. This was a car with hydraulic transmission, and was truly gearless, there being no differential gearing, this not being necessary owing to the design.

The principle was a rotary pump driven by the engine pumping liquid from a sump along a pipe-line to two larger rotary motors (one being fitted to each half of the rear axle shafts); a special relief valve was fitted in order to regulate the speed.

The mechanism was fitted to a Charron chassis. I don't believe anything came of it, but I do know the above statement is fact, as in the year 1912 I applied for a Provisional Protection for Patent application, for a similar idea during the month of April of that year, and the patent office turned my application down owing to the fact (so they stated) that Lentz of Germany had filed both provisional and final specifications together during the preceding month (March), and thereby nullified my application.

The only difference between my idea and that of Lentz was that I used three or four small rotary pumps in line on the main engine shaft, so that either one, two, three, or all four, could be run in parallel, and thus efficiently govern the call upon the load applied to the transmission.

However, all this is now past, but like Mr. Westbury, I do believe that it is not all wasted energy: we have learnt a good deal, leaving still a deal more to learn

Yours faithfully,

Mansfield. J. B. S. POYSER.

[We are obliged to the above correspondents for the information on various types of transmission systems, which will be of interest to many of our readers. It is possible, even yet, that one or other of these systems may reappear in an improved form and may even eventually supplant the conventional type of gearbox. The car mentioned by our contributor, however, was one which actually bore the title "GEARLESS"; up to the present, exact information about this particular car is lacking, and we should be obliged for any information concerning it which readers may be able to furnish.—Ed., "M.E."]

Restoring Castings

DEAR SIR,—Recently I have had occasion to: (*a*) press on a cast-iron flange to an iron casting; (*b*) put in a cast-iron liner in a spongy cylinder casting 2½ in. long. In both cases I succeeded by the following method without any fracture taking place.

The parts were machined carefully to size and then the parts to fit were rubbed with a copper sulphate crystal moistened with spittle—which is slightly acid, of course. Copper was at once deposited on the iron in a thin coating, and gave a sliding surface which covered the crystal points of the iron sufficiently to enable them to be pressed home easily.

The cylinder was bored out to maximum size, leaving a thin wall.

The liner was a chunk of sash weight from the scrap-box —and fortunately, turned out to be lovely metal.

The weight was turned down, treated as above, and while still solid, the cylinder pressed on with the tailstock.

Then it was bored out to size and finally sawn off.

This was done on an old 4 in. Drummond lathe.

Perhaps this restoration may give an idea to someone who has experienced a similar poor casting.

Yours faithfully,

Bryn. JOHN L. WATERHOUSE.

Ship Propulsion

DEAR SIR,—It is written that "Fools rush in, etc.," but I would, nevertheless, suggest that the conclusions expressed in Mr. W. G. Iliffe's letter in your issue of September 11th, upon the above subject, are far from correct.

In maintaining that the propeller has an easier job because it is working in the "wake" of the ship, Mr. Iliffe overlooks the fact that that very same "wake" is one result of the propeller's work, and a loss at that. Suppose the hull to be so badly designed that the "wake" in which the propeller worked was equal in velocity to the forward speed of the ship. Then $V = U$ and then the expression $\frac{F(V - U)}{\eta} = 0$ ft./lb./sec. and no power will be absorbed in driving the ship forward.

I have put the word "wake" in inverted commas because I am under the impression that the wake of a ship driven by a propeller would be the water forced backwards as a result of the propeller thrust.

Yours faithfully,

Maidenhead. B. A BUTT.

Scale Cylinders and Boilers

DEAR SIR,—In your issue of September 4th, page 186, I notice Mr. Harrison's reference to the question of scale-size boilers steaming scale-size cylinders, and his doubt whether it would be possible for "1" gauge. Is not the question really: Why should it not be possible? The answer to this, from the theoretical point of view, seems obviously to be: It is possible, provided that the conditions in "1" gauge are similar to those appertaining to 2½-in. or any larger gauge. That is to say, the boiler must be of scale diameter and length, and coal-fired, and the cylinder must have scale diameter and stroke. Apparently, however, nobody has yet had pluck enough to build a gauge "1" locomotive satisfying these conditions; so a practical answer to the question is, therefore, not available yet.

Not so many years ago, there were many model engineers who went so far as to assert that to expect a scale-size boiler to steam scale-size cylinders was ridiculous; all manner of technical theories were put forward in support of this idea, and so many miniature locomotives that had been built on this principle were such abject failures that it seemed as though the assertion were only too true. Later, a little wisdom, combined with enthusiastic practical enterprise, prevailed, with the result that miniature locomotives which in appearance and general dimensions are strictly to scale, are successful and trouble-free workers, in *all* scales down to 2½-in. gauge; moreover, there are now probably more of them in 2½-in. gauge than in any other, which suggests that small size is no bar to success.

Finally, I would like to ask if Mr. Greenly could be prevailed upon to give some proof of the remarks he makes on page 208 of your September 11th issue. Can he ever have seen, as I have seen, say a 2½-in. gauge locomotive, with *scale-size* boiler and cylinders, notched up almost to mid-gear, running literally mile after mile, and hauling three adults the while? If, in these conditions, the steam is not being used expansively in the cylinders, how *is* it being used? If the cut-off is increased, the consumption of fuel and water is at once increased; how is this to be explained, except by the fact that the steam is being used less expansively owing to the longer cut-off? Therefore, there must be some difference in steam consumption between long and short cut-off.

Yours faithfully,
"CHURCHWARDIAN."

Steam Cars

DEAR SIR,—It looks as if some more information on steam-driven cars would be acceptable. Time was when readers were impatient of articles and letters not pertaining to their requirements, but we are getting used to reading your paper more carefully and finding satisfaction in all classes of articles. I do not build loco. engines, but "L.B.S.C.s" columns have provided me with much useful information, and I'm a qualified sea-going and refrigerating engineer, 50 years of age. Reverting to steam car topics, boilers and engines, and the heating thereof, are of interest to all steam enthusiasts, and there is plenty of scope for better work yet. One might say that the subject was dropped when it began to get difficult. As regards boilers, I gave "L.B.S.C." an idea for a water-tube boiler, and have the construction of one now in hand. It has 19 field tubes, extended internally into the steam space, and the feed tubes feeding the field tube from the bottom of the steam and water drum. The idea is to get the steam direct into the steam space without displacing and being condensed into water. I'm also interested to know *how much* steam can be got in a given time off every square inch of *water or steam surface*. This represents the *limit* in steam-making capabilities of any boiler.

Yours faithfully,
S. Norwood. C. W. LEECH.

Clubs

Norwich and District Society of Model Engineers

Mr. A. A. Taylor's lecture on "Typewriters and Calculators" was postponed, and will now be held on Thursday, October 16th, at 7.30 p.m.

Hon. Sec., J. POWELL, 29, Spinney Road, Thorpe, Norwich.

Leeds Model Railway and Engineering Society

A talk by Mr. M. Hedley took place on September 21st, in which he discussed the future of model engineering relative to the standardisation of measurements. A discussion followed.

Hon. Secretary: H. E. STAINTHORPE, 151, Ring Road, Farnley, Leeds.

Glasgow Society of Model Engineers

The annual general meeting of the above society, held on Saturday, September 20th, was well attended. All items on the agenda were satisfactorily dealt with and a vote of thanks was given for the officers and council, whose untiring efforts made possible, in these unsettled times, a fully paid membership figure of well over the century mark.

The first of six meetings arranged for the coming winter session will take place at the Club rooms, 143, West Regent Street, Glasgow, on October 18th, at 7.30, when Mr. D. C. Young will lecture on "The Proportions of Model Boats."

Hon. Sec., JOHN W. SMITH, 785, Dumbarton Road, Glasgow, W.1.

The Junior Institution of Engineers

Future meetings of the above institution are :—

Saturday, 18th October, 1941, at 39, Victoria Street, S.W.1, at 2.30 p.m. Ordinary meeting. Paper, "Fire Fighting and the Engineer," by J. W. Stenson (member).

Saturday, 8th November, 1941, at 39, Victoria Street, S.W.1, at 2.30 p.m. Informal meeting. Paper, "Mills and Mill Gearing," by Rex Wailes (member).

Saturday, 15th November, 1941, at 39, Victoria Street, S.W.1, at 2.30 p.m. Annual General Meeting.

Saturday, 29th November, 1941, at 39, Victoria Street, S.W.1, at 2.30 p.m. Ordinary meeting. Paper, "The Engineer and the Rest of the World—a study in relationships," by K. S. Jewson (member).

Lord Sempill, A.F.C., F.R.Ae.S., has accepted the invitation of the Council to become President of the Junior Institution of Engineers (Incorporated) for next Session, 1941-42.

Altrincham Model Power Boat Club

The next meeting of the above club will be held at the address below on Sunday, October 12th, commencing at 2.30 p.m.

Hon. Secretary: O. B. BATES, 2, Hereford Villas, Hereford Street, Sale.

NOTICES.

The Editor invites correspondence and original contributions on all small power engineering and electrical subjects. Matter intended for publication should be clearly written, and should invariably bear the sender's name and address.

Readers desiring to see the Editor personally can only do so by making an appointment in advance.

All subscriptions and correspondence relating to sales of the paper and books to be addressed to Percival Marshall and Co. Ltd., Cordwallis Works, Cordwallis Road, Maidenhead, Berks. Annual Subscription, £1 10s., post free, to all parts of the world.

All correspondence relating to advertisements to be addressed to THE ADVERTISEMENT MANAGER, "The Model Engineer," Cordwallis Works, Cordwallis Road, Maidenhead, Berks.